

BRIEF REPORT

Cause, Type, and Workers' Compensation Costs of Injury to Fire Fighters

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Background *Work-related injury rates in the fire service industry exceed those for most other industries, however little is known about the cost of injury to firefighters.*

Methods *This is a preliminary investigation of detailed worker's compensation records of firefighter injuries, 1,343 claims in all, collected from 1992–1999. Summary statistics and regression analysis regarding the cause, nature, and cost of injury to firefighters are presented.*

Results *Overexertion accounted for a significant portion (over 1/3) of injuries to firefighters, typically involved injuries to the back, and was associated with significantly higher costs than other types of injuries. The per-claim average worker's compensation cost of injury to firefighters was \$5,168 and the average for injuries caused by overexertion was \$9,715.*

Conclusions *Overexertion is a costly source of injury to firefighters that can likely be reduced through policy intervention.* Am. J. Ind. Med. 43:454–458, 2003.

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KEY WORDS: *injury; worker's compensation; costs; cause; overexertion*

INTRODUCTION

The fire service remains one of the country's most hazardous industries with work-related injury rates exceeding those for most other industries [International Association of

Firefighters, 1999; Karter and Badger, 2001]. For example, in 1998 the incidence of work-related injury in the fire service was over four times that for private industry with one of every three firefighters injured in the line of duty [International Association of Firefighters, 1999]. In 2000, the National Fire Protection Association (NFPA) reported 84,550 firefighter injuries that required medical treatment or resulted in at least 1 day of restricted activity [Karter and Badger, 2001].

Consistent with prior years, the most recent statistics for 2000 show that the leading cause of injury to firefighters was overexertion, which accounted for 31.4% of all firefighter injuries [Karter and Badger, 2001]. Overexertion "occurs when the physical effort of a worker who lifts, pulls, pushes, holds, carries, wields, or throws an object results in an injury" [Webster, 1999]. These activities comprise a significant portion of firefighter job tasks, and include such activities as transporting patients and carrying heavy equipment [Conrad et al., 2000; Lavendar et al., 2000a,b]. The high proportion of injuries related to overexertion for firefighters is similar

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among workers in private sector industries, where overexertion accounted for 27% of occupational injuries [Bureau of Labor Statistics, 2001].

Though firefighter injuries have been frequently examined, worker compensation costs associated with these injuries are virtually unknown. To our knowledge, only two prior studies have examined injury costs, and they were physical fitness program evaluations that found that firefighters who participated in the respective physical fitness program incurred fewer medical costs [Cady et al., 1985; Hilyer et al., 1990]. In addition, the only prior study to use workers compensation data was a pilot analysis of 41 firefighter time-lost worker compensation cases from New Hampshire, which found that overexertion was the major cause of injury (45.5%) and that strains/sprains accounted for an astounding 72.7% of time-lost injuries, but it did not examine costs [Karter, 1996].

To our knowledge, there is no published large-scale study that has examined the relationships among the cause, nature, and costs of firefighter injury. A better understanding of the costs of injury to firefighters, and how those costs relate to the cause and the nature of those injuries can help inform policy decisions regarding the occupational health of firefighters [Musich et al., 2001]. Such information can serve to document financial incentives to infuse dollars into firefighter injury prevention and suggest priority areas for further study.

METHODS

This report is a retrospective cross-sectional secondary analysis of data collected between 1992–1999 from detailed workers' compensation records of firefighter injuries.

Data Source

The data were provided by a large, non-profit risk-pooling firm that provides worker compensation coverage to 77 municipalities located in northeastern Illinois, which amounts to roughly a quarter of the departments in that area. The company maintains computerized records derived from all of their worker's compensation claims since 1979. We used data from 1992–1999 because they allowed the identification of firefighters by both a workplace code (fire department) and an occupational code (firefighters). In the sample covering 1992–1999, out of approximately 13,680 covered fire fighters, there were 1,343 claims.

The claims data contained detailed cost information for every contracted firefighter that was injured on the job. For closed claims, the costs were the total amount paid. For open files (30 of the 1,343), there were internally generated estimates for total cost based on the type of injury and other information. The costs were divided into five categories: medical, compensation and indemnity (lost work time and court awards are combined in this category), legal fees,

vocational therapy, and other expenses (e.g., court reporters). An attractive feature of the cost data is that because the claims are handled internally, the data reflected actual cost. Direct measures of costs provide a more accurate measure of resource use than the more typical charge data available from most medical claims.

The data set also contained detailed codes for the cause and nature of injury experienced by firefighters as well as information on contributing factors for the injury (i.e., reported reasons for the injury). The codes were based on information collected from an "Employer's First Report of Injury" form that must be completed by a supervisor, and includes detailed descriptions of the cause and nature of injury. According to the company, most often, the worker had seen a physician prior to the claim being initiated. Generally, there is one cause and one corresponding nature of injury per claim; however, in cases where there are multiple injuries or causes, the primary cause and nature are identified and coded.

In addition to cost, cause, and nature of injury, the data contained age, gender, year of the claim, and anonymous identifiers for the fire department and the individual firefighters.

Measures

The analysis focuses on measures of cause, nature, and cost of injury. Note that the nature of injury refers to the outcome as a result of the injury, while cause refers to what action created the injury. For cause of injury, we used major categories from the company. For example, the injuries we code as having a cause of "overexertion" are an aggregate of "lifting," "pushing or pulling," "twisting/turning/bending/kneeling," "reaching or throwing," "holding or carrying," "repetitive motion/carpel tunnel," and "strain/sprain not otherwise classified."

For nature of injury, there were fewer codes to aggregate from the raw data, and no suggested larger categories. However, some aggregation was performed to simplify the presentation of the results and to make the data more comparable to other standard injury coding schemes (e.g., International Association of Fire Fighters codes).

For costs, we examined total costs and medical costs. All costs were transformed into 1997 dollars using the consumer price index. We then incorporated some analyses of body part and contributing factors. For these variables, codes for body part injured and the contributing factor for the injury were directly adopted.

Statistical Analysis

We examined frequency distributions of the cause and nature of injury, the body part affected, and the contributing factor. Mean and median medical and total workers' compensation costs were calculated for injuries to firefighters,

and mean and median costs across cause and nature of injury were examined. We then used 1,107 of the 1,343 claims with no missing values in any variables to conduct ordinary least squares regression of the log of total worker’s compensation costs on indicators for the year of the claim (with 1992 as the comparison), age of the firefighters, an indicator for cause of injury being overexertion, and an indicator for nature of injury being strain or sprain (separate specifications with each indicator were performed). The natural log of costs was used in the regression analysis to account for skewed costs. All analyses were conducted using SAS software (version 6.12 for Windows).

RESULTS

The average age of the firefighters was 35 years. Almost 96% of the claims were for male firefighters, which is consistent with national demographics. The overall rate of worker’s compensation claims per firefighter was approximately 0.11, and the rate of injury related to overexertion was 0.04.

Table I shows that, in terms of cause, overexertion accounts for 33% of the injuries claimed by firefighters. In

terms of nature, strains and sprains account for 38% of the injuries claimed by firefighters. In results not shown in the Table, the cause of injury being overexertion is significantly related to the nature of injury being strain or sprain. For example, 83% of injuries with a cause of overexertion have a nature of injury of strain or sprain. Other nature of injury codes related to a cause of overexertion were cuts, lacerations, bruises (5%) and others (12%) that could have arisen from coding issues such as multiple injuries, or from unusual combinations of events, which we could not identify.

In other analyses not shown in the tables, we found that 49% of overexertion related injuries had a specific cause of “lifting” and 42% of the injuries with a cause of overexertion affected the lower back. Among the contributing factors corresponding with injuries caused by overexertion, “Inadequate help/procedure for heavy lifting” was coded in 42% of the claims.

In terms of cost, overexertion related injuries were associated with high workers’ compensation costs. The overall per-claim mean workers’ compensation cost of injury to firefighters was \$5,168, and the mean for overexertion related injuries was \$9,715. In medical costs alone, the per claim average was \$1,973 overall and \$3,458 for overexertion

TABLE I. Medical Only and Total Workers’ Compensation Cost of Injury by Cause and Nature of Injury

	N	%	Medical			Total		
			Mean	Median	Max	Mean	Median	Max
All	1,343		\$1,973	\$370	\$81,993	\$5,168	\$397	\$272,042
Cause of injury								
Missing	1	0	223	223	223	228	228	228
Slip, trips or fall	175	13	3,147	559	46,969	8,662	649	174,394
Struck by objects	152	11	1,166	293	59,872	2,621	310	202,721
Overexertion	449	33	3,458	582	81,993	9,715	758	272,042
Striking against/stepping on	23	2	270	257	803	306	260	1,512
Caught in between or under	11	1	348	275	601	358	292	614
Cut/punctures/scrape	105	8	676	356	14,638	876	329	20,883
Burns/exposure to	365	27	444	290	7,214	534	296	16,170
Inhalation/ingestion	11	1	966	283	7,330	1,312	291	11,097
Stress/exhaustion	38	3	1,121	643	6,039	3,217	955	33,484
Motor vehicle	11	1	6,254	1,133	34,997	19,590	1,489	100,641
All other	2	0	1,698	1,698	2,379	6,457	6,457	11,897
Nature of injury								
Missing	37	3	1,939	431	19,035	4,174	476	56,583
Strain/sprain	508	38	3,023	559	57,106	8,031	654	186,637
Cut/laceration/fracture	292	22	1,236	321	59,872	3,452	332	202,721
Burns	44	3	664	239	14,638	1,186	246	20,883
Asphyxiation/inhalation	37	3	1,063	546	6,201	1,080	589	6,201
Eye injury	54	4	245	212	771	252	213	854
Heart disease	3	0	182	0	547	33,242	557	98,764
Others combined	368	27	1,626	312	81,993	4,055	332	272,042

All costs are measured in 1997 dollars.

related injuries. The data indicate a skewed distribution typical of medical costs, with means well above medians. The median total costs of overexertion injuries were \$758 versus an overall median cost of \$397.

Table II depicts the ordinary-least-squares regression analysis, which indicated that a cause of injury of overexertion and/or a nature of injury of strain or sprain was significantly positively related to the log of total workers' compensation costs controlling for the year of the claim and the age of the injured firefighters. Specifically, injuries related to a cause of overexertion were 89% more costly than other causes of injury, controlling for age and year. Similarly, injuries that resulted in strains and sprains were 80% more costly than other injury outcomes.

Taking total costs from overexertion, and dividing by the average number of firefighters per year results in an approximate cost of \$319 per firefighter per year that is associated with injuries from overexertion.

DISCUSSION

Our results suggest that injuries caused by overexertion are a significant problem to fire departments. The finding of overexertion as a primary cause of injury is consistent with the findings reported by the IAFF and NFPA. In our study, over 1/3 of all injuries and over 80% of overexertion injuries resulted in strains and sprains to the firefighters. These results are slightly lower than the 47.5% reported by the NFPA and the 43.5% reported for U.S. workers [Bureau of Labor Statistics, 2001; Karter and Badger, 2001].

Some of the factors reported as contributing to injury are consistent with factors previously identified in a series of fire

service focus groups regarding what they thought contributed to musculoskeletal injuries: heavy lifting, staffing, training, unsafe posture, inattention/fatigue, and physical environmental conditions [Conrad et al., 1994]. While external environmental conditions, such as wet, slippery surfaces may not be very amenable to intervention, many of the other personal and workplace contributing factors could be the focus of prevention initiatives such as ergonomic and physical fitness programs [Reichelt and Conrad, 1995].

Four noteworthy limitations exist. First, the data covered only suburban firefighters whose municipalities selected to use this risk management company for their worker compensation insurance coverage. Hence, large urban fire departments were not represented. Despite this limitation, the results are quite consistent with other firefighter injury statistics and track well with the rates reported for the U.S. worker population. Second, the data regarding cause and nature of injury are based on codes developed specifically for the worker compensation insurance industry and not necessarily for injury surveillance. Detailed operational definitions of the codes were not available, which added to the difficulty of directly comparing results with IAFF and NFPA statistics.

Third, the definition of an injury differed among organizations. In our study, an injury was defined as one that resulted in the filing of a worker compensation claim. This definition is more restrictive than that used by the IAFF and the NFPA [International Association of Firefighters, 1999; Karter and Badger, 2001]. Both of them define an injury as an incident that required, or should have required, treatment by a practitioner of medicine within 1 year of the incident regardless of whether treatment was actually received. The NFPA also includes injuries that result in at least 1 day of

TABLE II. Regression Results: Log Total Cost on Cause and Nature of Injury Related to Overexertion

Independent variables	Model with indicator for cause =	Model with indicator for nature =
	overexertion	strain/sprain
Intercept	4.8668 ^a	4.6701 ^a
Year = 1993	-0.2240	-0.0254
Year = 1994	0.2264	0.2489
Year = 1995	0.0828	0.0460
Year = 1996	0.1302	0.0850
Year = 1997	-0.0037	0.0702
Year = 1998	0.1612	0.2191
Year = 1999	0.5064 ^a	0.5187 ^a
Cause = overexertion	0.8875 ^a	
Nature = strain/sprain		0.8008 ^a
Age	0.0283 ^a	0.03118 ^a
Sex = male	0.1185	0.1960
R squared	0.0987	0.1057
Observations	1,107	1,107

^aStatistical significance at the 5% level. The coefficients are from ordinary least squares regressions.

restricted activity immediately following the incident [Karter and Badger, 2001]. Finally, as is true of NFPA and IAFF statistics, the nature of injury is not based on medical diagnostic codes. This lack of precision limits the validity of the nature of injury variable. Nevertheless, we believe that the results of this study are informative for policy considerations.

CONCLUSIONS

Overexertion is relatively a costly source of injury to firefighters that can likely be impacted through policy. Eliminating injuries caused by overexertion from 1992 to 1999 would have saved on average \$545,000 per year, which translates into approximately \$319 per firefighters per year in direct costs. Methods to reduce the occurrence of overexertion injuries include ergonomic interventions aimed at equipment and task redesign, as well as physical fitness programs [Reichelt and Conrad, 1995; Conrad et al., 2000]. More emphasis needs to be placed on acquiring occupational data regarding the cause of injury. In addition, efforts should be made to improve the coding and definitions of both nature and cause of injury to facilitate research and policy.

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